

ulation sequences for tasks such as retrieving books and serving food. The French Spartacus robotic aid made other contributions to the evolution of the field of robotics.

During the past eight years, the Stanford University and the Veterans Administration Rehabilitation Engineering and Research Center, in collaboration with the Spinal Cord Injury Center (all in Palo Alto, California), have explored through a number of projects the potential use of robots as assisting devices for severely disabled persons. A wide range of users successfully commanded a robot to perform preprogrammed self-care tasks such as providing drinking water, grooming the hair, brushing teeth, and cleaning the face. A third-generation desktop robotic assistant has already been developed and clinically evaluated for persons with high-level quadriplegia. Advances in speech-recognition technology and commercial computer hardware and software have significantly augmented the uses of the system PUMA-260 robot manipulator. Efforts are currently being directed to develop a desktop system that would be useful for a skilled computer scientist in an office setting. The most recent developments in progress include a controlled mobile manipulator consisting of a commercial robotic arm equipped with sensors and mounted on an omnidirectional vehicle, useful to a handicapped person confined to a bed or wheelchair.

Ordinarily no knowledge of computer programming is required to operate the robotic arm; the on-board microprocessor is preprogrammed by a therapist to perform complex tasks in response to one or two commands from the user.

INDER PERKASH, MD
Palo Alto, California

REFERENCES

- Awad RE, Engelhardt KG, Leifer LJ: 1983 Development of Training Procedures for an Interactive Voice-Controlled Robotic Aid. Proceedings of the Rehabilitation Engineering Society of North America's 6th Annual Conference, San Diego, 1983, pp 276-278
- Seamone W, Schmeisser G: Early clinical evaluation of a robot arm/worktable system for spinal-cord-injured persons. *J Rehabil Res Dev* 1985; 22:38-57

Prophylaxis and Control of Seizures in Brain-Injured Patients

POSTTRAUMATIC SEIZURES are estimated to occur in approximately 5% of all patients with head injuries and anywhere from 20% to 60% of those with penetrating head injuries. The issue of seizure prophylaxis or treatment following a brain injury often arises in the early days after the injury. Treatment is often instituted with either intravenous phenytoin or phenobarbital in the neurosurgical unit, with conversion to the oral form when the patient is transferred to the rehabilitation service.

Investigators have recently been evaluating the cognitive effects of the use of phenytoin, phenobarbital, or carbamazepine on both persons newly diagnosed with epilepsy and those known to have epilepsy. These studies have important implications for the head-injured population because a disordered cognitive state already exists and further disruption may impede the rehabilitative effort. A comparative study showed little difference in the efficacy of these drugs in controlling tonic-clonic seizures.

In newly referred patients with epilepsy, the use of carbamazepine is associated with a better performance on memory tasks compared with that of phenytoin. Although no significant difference was found on mood ratings between the

two drugs, higher blood concentrations of carbamazepine yielded lower ratings for anxiety, depression, and fatigue.

In epileptic patients whose regimen is changed from other anticonvulsants to carbamazepine, tests of memory and concentration show significant improvement. Improved cognitive functioning has also been shown when the number of drugs is reduced without an adverse effect on seizure control.

Although no anticonvulsant study has specifically examined cognitive effects on patients with brain injuries, based on the available data, it seems appropriate to recommend using carbamazepine as the first-line agent in this patient population. Phenytoin is an appropriate alternative if carbamazepine use is not tolerated. Phenobarbital is the least appropriate drug because of its sedative and cognitive effects.

DAVID D. KILMER, MD
GREGORY T. CARTER, MD
JAMES S. LIEBERMAN, MD
Sacramento, California

REFERENCES

- Andrewes DG, Bullen JG, Tomlinson L, et al: A comparative study of the cognitive effects of phenytoin and carbamazepine in new referrals with epilepsy. *Epilepsia* 1986; 27:128-134
- Mattson RH, Cramer JA, Collins JF, et al: Comparison of carbamazepine, phenobarbital, phenytoin and primidone on partial and secondarily generalized tonic-clonic seizures. *N Engl J Med* 1985; 313:145-151
- Thompson PJ, Trimble MR: Anticonvulsant drugs and cognitive functions. *Epilepsia* 1982; 23:531-544

Advances in Surgical Reconstruction of Upper Extremities in Quadriplegia

THERE IS INCREASING INTEREST in and awareness of the role of surgical reconstruction for paralyzed upper limbs of patients with quadriplegia. A greater number of Veterans Administration and other public and private spinal cord injury centers are offering the possibility of surgical reconstruction to their quadriplegic patients, and an increasing number of patients are undergoing reconstruction in the hope of gaining more independence.

In the past decade novel operative techniques have been developed that extend the possibility of reconstruction to patients with more proximal cervical cord lesions. A useful international classification system has been developed that categorizes patients not on the spinal level of injury but by their remaining functioning upper extremity muscles. As spinal cord injury centers have gained experience with sufficient numbers of patients who have had such operations, ideas about the role and timing of upper extremity reconstruction in the overall rehabilitative process have taken form.

We recently reviewed our ten-year experience at two centers, the spinal cord injury services at the Palo Alto (California) Veterans Administration Medical Center and at Denver's Craig Rehabilitation Institute. During this period more than 400 patients with quadriplegia were examined and more than 170 patients underwent some type of surgical reconstruction for their upper extremity carried out in almost 250 operative procedures. For those patients whose only remaining function was active wrist extension, a one-stage key pinch between thumb and index finger was done (72 limbs). For those patients with a greater number of remaining functional forearm muscles (67 limbs), a two-stage procedure provided both active digital grasp and release and a strong thumb pinch. Active release was accomplished in the first stage and grasp and pinch provided in the second stage. In 40